



Agricultural Research Institute, Pusa

# THE COTTON WHITE-FLY (*Bemisia gossypiperda*, n. sp.)

BY

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## The Cotton White-Fly.

(*Bemisia gossypiperda*, n. sp.)

(Received for publication on 12th February 1929.)

The Cotton White-fly was noticed for the first time on cotton in Bihar in the year 1905, when varieties of cotton were grown on the Pusa Farm to test their suitability for adoption in North Bihar, where the cultivation of indigo had fallen off owing to the introduction of synthetic indigo. It was then, as now, noticed to be present more on the broad-leaved varieties of cotton than the short-leaved ones. Since then it has been present on cotton at Pusa but not to any large extent so as to be considered as a pest. The Economic Botanist to the Government of the Punjab noticed it on cotton at Lyallpur in the year 1915. In 1925 it was again found in numbers on cotton in the neighbourhood of Lyallpur in the Punjab. Of late it has been much in evidence on cotton and especially in the Punjab. It has also been present to a large extent on the Farm of the British Cotton Growing Association (Punjab) Ltd., Khanewal, and the cause of the diminishing outturns of cotton on that Farm has been attributed to the abnormal presence of the cotton white-fly—*Bemisia gossypiperda*, n. sp., on cotton, especially the broad leaved varieties 4 F., 285 F. and 289 F. In July last year the Director of the British Cotton Growing Association (Punjab) Ltd., wrote thus to the Imperial Entomologist :—

“ \*\*\* In view of the very considerable financial losses which Zamindars have suffered in this locality in the past, amounting to 4 to 10 maunds (Rs. 56 to Rs. 110) per acre, we trust you will give the matter the attention which it appears to us to merit. We may inform you that we are prepared to undertake an intensive campaign against this pest on all our cotton crops provided you can furnish us with the technical advice which we now seek.” Three months later, the Director of the same company wrote to the Imperial Entomologist, Pusa :—

“ \*\*\* In this it may interest you to know that the undersigned suspected during the early part of the cotton season that this Aleyrodid pest may well be responsible for the considerable amount of damage done to the cotton crop in the locality during the past two seasons and he anticipated a recurrence of the damage in the present season. He has now arrived at the definite conclusion that the primary cause of this

damage which results in the depreciation of the cotton crop in this part of the Punjab to the extent of crores of rupees annually is the white-fly. \*\*\* We are prepared to expend considerable sums in the eradication of this pest and we are particularly desirous of gathering all possible information in time to enable us to take comprehensive, preventive and remedial measures for the next season crop."

The White-fly lays eggs preferably on the lower surfaces of leaves. Up to now, an adult female has been found to deposit 28-35 eggs. When a large number of flies oviposit on the same leaf, it becomes covered with innumerable, pale-yellow prediagnosed eggs broad at base and tapering apically (Plate I, fig. 1). Twenty-four hours after deposition the egg turns pale brown and a tiny light yellow larva (Pl. I, fig. 2) crawls about on the leaf for some hours in search of a succulent spot, after which it settles down, secretes a narrow waxy fringe and starts feeding by sucking the leaf sap. The larvae pass through four instars (Pl. I, figs. 2, 3, 4, 5) and the fourth instar passes directly into the pupal stage without a moult there being no clear demarcation between the last larval and the pupal instars. All the larval stages of the White-fly are passed on the host plant (Pl. I, figs. 3, 4, 5). If the underside of a cotton leaf be turned over and examined with a hand-lens—even magnifying diameters x8—it will be seen that it is studded with small pale yellow protuberances not larger than a pin head (Pl. I, fig. 11). In case of severe infestation of the cotton leaves not even a millimetre of leaf space is free from some stage of the pest. Each larva thrusts its proboscis into the tissue of the leaves and drains away the sap which should have gone to mature the bolls. Thus the plant nutrition is considerably hampered, the leaves, unable to respond to the drain of sap by myriads of insects, fall off prematurely, and the bolls, if they open at all, remain half opened on the plants. In some varieties of cotton, especially 4 F. of the Punjab, it has been noticed that the petioles of infested leaves become so weak that with the least touch or disturbance they fall off. It has also been noticed that the strength of fibre undergoes considerable deterioration. It not only shrivels up but loses its tensility also. In fact the crop in the affected locality gives diminishing outturns and the loss to the ryot is great. The affected fields present a blighted appearance and this is very prominent when broad-leaved varieties such as the Punjab 4 F., 285 F. and 289 F. are grown alongside of short-leaved varieties such as the Punjab *mollisoni* and Punjab *sanguineum*. In a recent examination of cotton on the British Cotton Growing Association Farm, Khanewal, Punjab, it was noticed that plots with 4 F. appeared blighted in comparison with *sanguineum* grown side by side. It was further noticed on

PLATE I.  
THE COTTON WHITE-FLY.

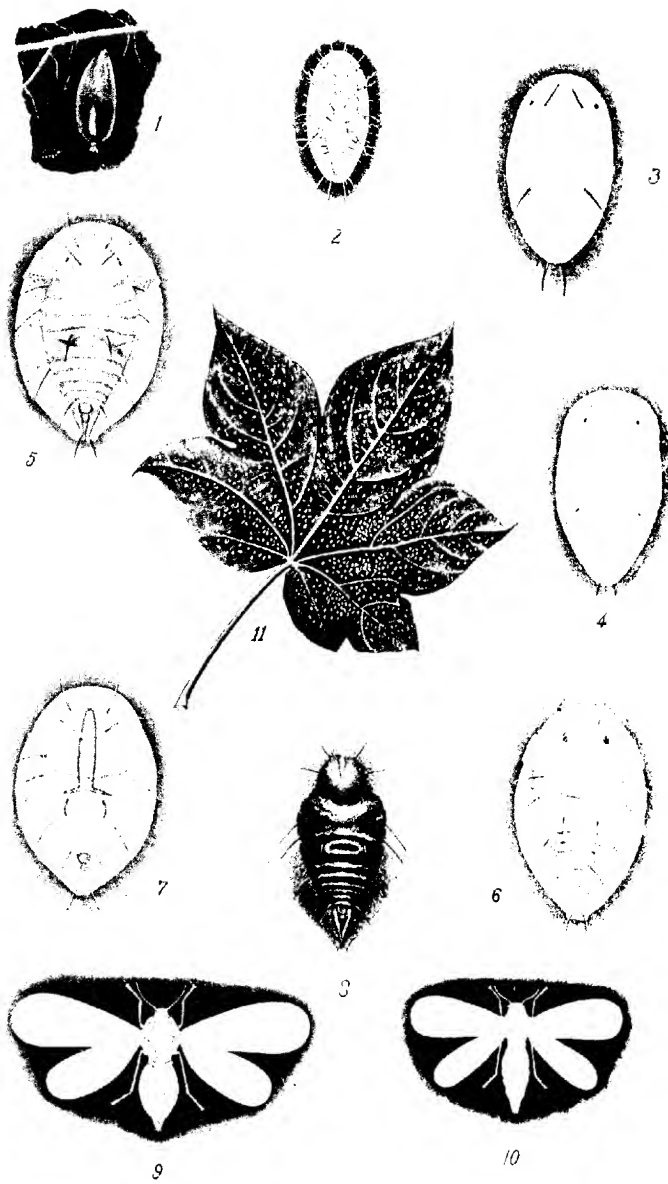
Fig. 1.—Egg	...	...	...	× 100
Fig. 2.—Larva 1st instar	...	...	...	× 100
Fig. 3.—Larva 2nd instar	...	...	...	× 100
Fig. 4.—Larva 3rd instar	...	...	...	× 80
Fig. 5.—Larva 4th instar	...	...	...	× 54
Fig. 6.—Pupa	...	...	...	× 54
Fig. 7.—Empty Pupa Case	...	...	...	× 54
Fig. 8.—Parasitized puparium	...	...	...	× 54
Fig. 9.—Male	...	...	...	× 57
Fig. 10.—Female	...	...	...	× 57

FIG. 11.—Leaf infested with larvae and puparia

# PLATE I.

## THE COTTON WHITE-FLY.

FIG. 1.—Egg	...	...	...	× 100
FIG. 2.—Larva 1st instar	...	...	...	× 100
FIG. 3.—Larva 2nd instar	...	...	...	× 100
FIG. 4.—Larva 3rd instar	...	...	...	× 80
FIG. 5.—Larva 4th instar	...	...	...	× 54
FIG. 6.—Pupa	...	...	...	× 54
FIG. 7.—Empty Pupa Case	...	...	...	× 54
FIG. 8.—Parasitized puparium	...	...	...	× 54
FIG. 9.—Male	...	...	...	× 27
FIG. 10.—Female	...	...	...	× 27
FIG. 11.—Leaf infested with larvæ and puparia				



*Bemisia gossypiperda*.





this farm that of all the broad-leaved varieties of cotton 4 F. was the worst sufferer. It seemed to be especially susceptible to the attack of the White-fly. Plots with 4 F. cotton in them were bare, whilst *sanguineum* grown close to these were green and healthy with plenty of bolls on them. From what has hitherto been studied of the pest so far it appears that the White fly reaches its maximum development by the end of August when the majority of plants become infested. At first this is not apparent as the larvæ and pupæ are concentrated on the lower surface of leaves. From July onwards the White fly continues to multiply thereby considerably lowering the vitality of the plants. At Khanewal as many as 529 larvæ and pupæ were found in a square inch on Bhindi (*Hibiscus esculentus*) leaves. At Pusa 260 larvæ were found to the square inch on cotton leaves received from Khanewal for examination.

The pupæ, along with the larvæ, remain on the lower surface of the leaves. When the pupa is fully matured, the imago within becomes plainly visible. The two red spots, which develop, represent the eyes of the developing imago within it (Pl. I, fig. 6). When about to emerge a T-shaped slit appears on the dorsum (Pl. I, fig. 7) and the adult comes out with crumpled wings. After 10 to 15 minutes the wings become fully expanded and the adult moves away. The duration of each instar varies from 3 to 4 days and the total life cycle, from the egg to the adult, lasts from 12 to 17 days in August and September when the average mean temperature is 84°F. and the average mean humidity is 87 per cent. The adults are tiny active creatures with creamy yellow bodies, a pair of wings covered with a whitish meal and a pair of deep maroon eyes. The male (Pl. I, fig. 10) is smaller than the female (Pl. I, fig. 9) and is readily distinguished by a pair of claspers at the abdominal end.

Besides cotton, the White-fly, *Bemisia gossypipeda*, n. sp., has hitherto been noticed on the following alternative food plants:—

Turnip (*Brassica campestris* var. *capa*); mustard (*Brassica campestris*); brinjal (*Solanum melongena*); potato (*Solanum tuberosum*); Bhindi leaves (*Hibiscus esculentus*); cauliflower (*Brassica oleracea*); cabbage (*Brassica oleracea caulimajpa*); Cape gooseberry (*Physalis peruviana*); Palwal (*Trichosanthes dioica*); Phoont (*Cucumis Melo*); sonji (*Cleome viscosa*); Bhat Katai (*Solanum xanthocarpum*); Dudhi (*Euphorbia pulchifera*); Tetari (*Lantana asplenifolia*); Chichra (*Achyranthes aspera*); Banka (*Lippia geminata*); Pirha (*Trewia nudiflora*); Harsingar (*Nyctanthes arbor-tristis*); Bhant (*Chenopodium infundibulatum*); Indrayan (*Citrullus colocynthis*); and *Corchorus trilobatus*.

Of these, it has been found to breed in large numbers on Bhindi (*Hibiscus esculentus*); brinjal (*Solanum melongena*); Palwal (*Trichosanthes dioica*) and the Cape gooseberry (*Physalis peruviana*).

Hitherto the parasitization observed in the species has been very small. Only two species of *Chalcidoid* parasites have been bred out. The parasitized pupæ (Pl. I, fig. 8) turn dark grey or black, and the parasite emerges by making a clean circular hole mainly in the anterior part of the pupa. The amount of parasitization, as hitherto ascertained from material obtained through the courtesy of Mr. Robert Thomas of the British Cotton Growing Association (Punjab) Ltd., Khanewal, varies from 4 to 6 per cent. only. With an intensive study of the pest, extended over a wide range it might be possible to find a larger parasitization of the species in any locality which could then be used as a centre for the breeding and subsequent despatch of natural parasites to the infested localities.

The Cotton White-fly has hitherto been found at Pusa, Lyallpur and Khanewal in the Punjab. In the latter place it has been bad for the last three years. It is possible that the serious attack of the Cotton White-fly is only a passing phase, just as has been the case in the past with the rice leaf-hoppers *Nephotettix bipunctatus*\*, Fabr., and *Nephotettix apicalis*, Motsch., in the Chhattisgarh division of the Central Provinces. It is possible, as was the case with the Rice Leaf-hoppers, that with the automatic adjustment of climatic conditions, the White-fly on cotton might also disappear. If not, sustained drastic measures will have to be adopted to prevent the enormous loss annually caused by the White-fly to cotton. We, therefore, think that, if the attack persists, it would be worth while adopting the following measures against the White-fly.

1. Putting down selected trap crops during the quiescent period, especially from the beginning of March to the end of April and grubbing these up in time and burning them before the cotton sowings begin.

2. To sow varieties of cotton as late as possible so as to escape the maximum infective period of the White-fly.

3. To evolve types of cotton which are more or less immune to the attack of the White-fly.

4. To sow short leaved varieties of cotton in place of broad leaved ones, which are more susceptible to the attack of the White-fly.

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\* Misra, C. S.—The Rice Leaf-hoppers *Nephotettix bipunctatus*, Fabr. and *Nephotettix apicalis*, Motsch. *Mem. Dept. Agri. India, Ent. Series*, Vol. V, No. 5.

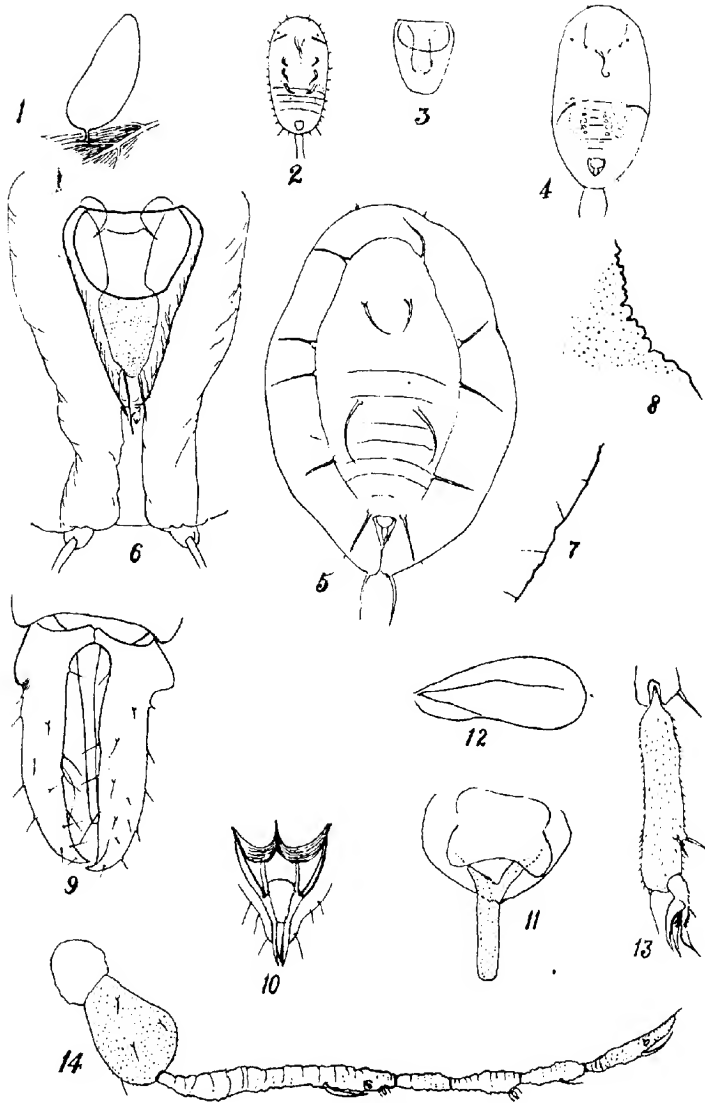
THE COLTON WHITE PAPER

[illegible]

## PLATE II.

### THE COTTON WHITE-FLY.

FIG. 1.—Egg . . . . .	× 125
FIG. 2.—Larva 1st instar . . . . .	× 110
FIG. 3.—Larva 1st instar: vasiform orifice . . . . .	× 600
FIG. 4.—Larva 2nd instar . . . . .	× 110
FIG. 5.—Pupa case . . . . .	× 110
FIG. 6.—Vasiform orifice of pupa case . . . . .	× 600
FIG. 7.—Margin of pupa case . . . . .	× 600
FIG. 8.—End of thoracic tracheal fold . . . . .	× 600
FIG. 9.—Male Genitalia (external) . . . . .	× 600
FIG. 10.—Female Genitalia (chitinated parts) . . . . .	× 600
FIG. 11.—Female vasiform orifice . . . . .	× 600
FIG. 12.—Male fore wing . . . . .	× 55
FIG. 13.—Male hind tarsus and claws . . . . .	× 600
FIG. 14.—Male antenna . . . . .	× 600



The Cotton White-Fly.



5. To spray cotton fields with power sprayers with especial arrangement to wet under surface of leaves when the plants are from 12" to 14" high.

6. Introduction of parasites and predators which would keep down the pest. Hitherto the parasitization has been found to vary from 4 to 6 per cent. but with intensive study of the pest over a wide range it may be possible to fix upon a locality where the parasitization of the species is fairly high.

*Benisia gossypiperda*, n. sp., is new to cotton and as such there is hardly any literature extant on the pest. We, therefore, describe it in full for the sake of ready reference.

*The egg* (Pl. II, fig. 1), is laid promiscuously on the lower surface of leaves. It is sub-oval in form with a short peduncle arising from the broad end. Chorion smooth and shiny without any sculpture. When laid freshly it is pale, translucent white. Twenty-four hours after it turns brownish yellow. Seventy-two hours after a pair of reddish spots, representing the eyes of the developing larva within, appear. Length .175 mm., breadth .081 mm., length of peduncle .019 mm.

Empty pedunculated eggs broad at base and pointed apically remain attached to the leaf with a longitudinal slit on them.

*Larva first instar* (Pl. II, fig. 2). Size .266 mm. by .133 mm., pale translucent white; mycetoma greenish yellow; eyes crimson, divided; shape elliptical with a narrow waxy fringe broken into bands all round the margin which is almost entire with 16 pairs of hairs on tubercles, 3 pairs on the cephalic, 3 on the caudal, the remaining small, laterally; the first and the third caudal pairs being longer than the remaining ones. A minute pair of hairs on cephalic submargin. Dorsal disk with the abdominal segments distinct. Vasisform orifice (Pl. II, fig. 3) .023 mm. by .027 mm., sub-trapezoidal, operculum sub-semicircular, filling about half the orifice, leaving about half of the spatulate, setose lingua exposed. Legs and antennae ordinary.

*Larva second instar* (Pl. II, fig. 4). Colour and shape as in the previous instar; .342 mm. by .152 mm. size; eyes undivided, margin finely crenulate with only three pairs of hairs, a minute pair on the cephalic, a long pair on prominent tubercle on the caudal, and a minute pair on the caudo-lateral margin. Dorsal disk with two pairs of long spine-like hairs, one pair laterad of the base of the mouth parts and the second pair near the anterior margin of the mycetoma. Instead of the mycetoma there is a row of about half a dozen circular, translucent spots on each side. Vasisform orifice and operculum as in the previous stage—lingua with a pair of hairs at the distal end. Conical rudiments of legs present; antennae absent.



*Larva third instar* (Pl. I, fig. 4). .475 mm. by .285 mm. in size; sub-oval in outline; margin crenulate with only a single pair of hairs on tubercles at the caudal end. Vasiform orifice triangular with the cephalic margin straight; operculum sub-semicircular, filling about half the orifice leaving about half of the spatulate, setose lingula exposed, distal extremity of the lingula provided with a pair of hairs touching the side of the vasiform orifice. The rest of the details as in the previous instar.

*Larva fourth instar and pupa* (Pl. I, figs. 5 & 6). The fourth instar passes into the pupal stage without a moult and in consequence differs little from the puparium, only it is flat owing to the absence of the developing imago within.

On a leaf the pupæ are convex, sub-elliptical with shallow indentures on the cephalothoracic and the caudal margins. Colour light yellowish; a pair of deep yellow pigmented patches on the abdomen and a flavous tinge at the end of the thoracic and the caudal tracheal folds, which have a narrow waxy fringe, the rest of the margin being without it; operculum brownish. Eyes of the developing imago within deep maroon.

Empty pupal cases (Pl. I, fig. 7) are transparent under the microscope. Margin (Pl. II, fig. 7) finely crenulate, with deeper indentations (Pl. II, fig. 8) at the termination of the thoracic tracheal folds which are dotted and faintly indicated. Three pairs of hairs on the margin, a minute pair on the cephalic, a long pair on prominent tubercles on the caudal and a minute pair caudo laterad; dorsal disk indistinctly demarcated by a faint line from the sub-lateral parts; with abdominal segments, and with seven pairs of long, spine-like hairs on prominent tubercles; a pair in front of the eyes and a pair behind them, two sub-lateral pairs on the thorax, a sub-medial pair on the second abdominal segment, a sub-lateral pair on the fourth abdominal segment and a pair cephalo-laterad of the vasiform orifice (Pl. II, fig. 6) which is triangular with the cephalic margin straight and the edges with short longitudinal folds; operculum sub-semicircular, filling about half the orifice, leaving the sub-conical distal half of the setose lingula exposed; tip of lingula armed with a pair of spines; vasiform orifice bounded laterad by faintly demarcated area continuing caudad with a narrow groove from the end of the orifice to the caudal margin. Length of pupal case .684 mm.; breadth .494 mm.; length of vasiform orifice .078 mm., breadth of vasiform orifice .055 mm., length of operculum .035 mm.

*Adult female* (Pl. I, fig. 9). Length from vertex to tip of ovipositor about 1.03 mm., light lemon-yellow in colour; eyes maroon, divided, body covered with fine, white meal. Antennæ of seven segments, segment I short, sub-globose; segment II sub-pyriform., .031 mm. long,

provided with about half a dozen spines on tubercles; segment III sub-cylindrical, .101 mm. long, imbricate, armed with two spiked sensoria and an ensiform spine near the distal end; segment IV much the same as the previous segment, .019 mm. long; segment V club-like, .031 mm. long with a spiked sensorium at the distal end; segment VI sub-cylindrical, .027 mm. long, with a short spine near the distal end; segment VII sub-fusiform, .039 mm. long imbricate proximally, profusely covered with minute hairs distally armed with an ensiform spine, a spiked sensorium and a minute seta at the tip.

Fore wing about .79 mm. by .22 mm., hyaline covered with a thin white meal; radial sector with an inconspicuous flexure, cubitus indicated as a hyaline streak. Hindwing concolorous, about .63 mm. by .28 mm.

Hind tibia .304 mm.; proximal hind tarsus .114 mm., distal tarsus .057 mm.; claws ordinary; paronychium narrow, acute, and curved, hairy at base.

Vasiform orifice (Pl. II, fig. 11) transversely elliptical; operculum sub-rectangular, almost filling the orifice leaving the cylindrical rod-like, setose lingula exposed which projects about the length of the orifice caudad; supports at the base of the valves of the ovipositor lightly built and curved, prominent spines at the tip of the abdomen (Pl. II fig. 10).

*Adult male* (Pl. I, fig. 10). Length from vertex to apex of claspers about .912 mm., in colour much the same as the female. Antennae (Pl. II, fig. 14) of seven segments, shape and armature of the segments much the same as in the female, length second segment .039 mm., III .089 mm., IV .023 mm., V .027 mm., VI .023 mm., VII .035 mm.

Forewing (Pl. II, fig. 12) about .68 mm. by .26 mm.; hind wing about .53 mm. by .21 mm. concolorous with the female.

Hind tibia .285 mm.; proximal tarsus .095 mm., distal tarsus (Pl. VI, fig. 13) .057 mm.; claws ordinary.

Vasiform orifice as in the female, the lingula reaching the cephalic end of the claspers (Pl. II, fig. 9) which are .082 mm. long, .027 mm. broad at the shoulder, narrowing distally, the tips smooth, curved inwards, armed with numerous acicular spines on tubercles, inner margin with a small, membranous expansion near the distal end and with about four prominent spines. Penis slightly narrowed distally, shorter than the claspers.

*Bemisia gossypiperda*, n. sp., is allied closely to *Bemisia religiosa*, Peal, which the late Mr. Peal found on pipal (*Ficus religiosa*) and Banyan (*Ficus bengalensis*) in one locality only in Calcutta.



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